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#### **Review Paper**

# Drug Repurposing an Effective Tool in Modern Drug Discovery

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#### ABSTRACT

Drug repurposing is using an existing drug for a new treatment that was not indicated before. It has received immense attention during the COVID-19 pandemic emergency. Drug repurposing has become the need of time to fasten the drug discovery process and find quickersolutions to the over- exerted healthcare scenario and drug needs. Drug repurposing involve side notifying the drug, evaluatingits efficiency using preclinical models, and proceeding to phase II clinical trials. Identification of the drug candidate can be made through computational and experimental approaches. This approach usually utilizes public databases for drugs. Data from primary and translational research, clinical trials, anecdotal reports regarding off label uses, and other published human data information available are included. Using artificial intelligence algorithms and other bioinformaticstools, investigat or ssystematically try to identify the interaction between drugs and protein targets. It can be combined with genetic data, clinical analysis, structure (molecular docking), pathways, signatures, targets, phenotypes, binding assays, and artificial intelligence to get an optimum outcome in repurposing. This article describes the strategies involved in drug repurposing and enlists a series of repurposed drugs and their indications.

#### **INTRODUCTION**

Drug repurposing, also known as drug repositioning or re-profiling, is the process of identifying new therapeutic uses for existing drugs or drug candidates. This approach can be advantageous for accelerating drug development, particularly in situations where a cure is urgently needed or traditional drug development is not costeffective.

#### Key aspects of drug repurposing:

- New Uses for Existing Drugs:
- Drug repurposing involves finding new therapeutic applications for drugs that are already approved or have been investigated for other conditions. Advantages:

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- It can be a faster and more cost-effective alternative to developing entirely new drugs. Focus on Pleiotropic Effects:
- Many drugs have multiple effects (pleiotropic effects), which can be exploited to target different diseases. Potential for Rare and Neglected Diseases:

Repurposing is particularly attractive for rare diseases where traditional drug development may not be economically viable.

#### MECHANISM OF DRUG REPURPOSING

It leverages the existing safety data and pharmacological profiles of these drugs, making it a faster and potentially less costly approach to drug development than traditional methods. This strategy is particularly useful for addressing unmet medical needs, emerging diseases, or when developing new treatments is resource-intensive.

- 1. Identification of Potential Repurposable Drugs:
- Serendipitous Discoveries:
- Literature-Based Research:
- In silico Approaches:
- Experimental Approaches:
- Off-label Use:
- Abandonment or Withdrawal:
- Patent Expiry:
- 2. Verification and Validation:
- Preclinical Studies:
- Clinical Trials:
- 3. Mechanisms of Action:
- Existing Mechanisms:
- Novel Mechanisms:
- Off-target Effects:
- 4. Advantages of Drug Repurposing:
- Reduced Development Time and Cost:
- Increased Efficiency:
- Addressing Unmet Medical Needs:
- Safety Advantages:

- 5. Challenges of Drug Repurposing:
- Potential for New Interactions:
- Resistance Development:
- Intellectual Property Concerns:
- Regulatory Hurdles:

#### METHODS OF DRUG REPURPOSING

Computational methods for drug repurposing leverage data analysis, machine learning, and network analysis to identify new uses for existing drugs, offering a faster and more cost-effective approach to drug discovery. Here's a breakdown of the key computational methods used in drug repurposing:

#### 1. Data Mining and Machine Learning:

- Data Sources: Researchers utilize vast databases of drug information, including chemical structures, drug-target interactions, disease characteristics, and clinical trial data.
- Machine Learning Techniques: Similaritybased methods: Identify drugs with similar properties or target inter actions to predict new uses.
- 2. Network Analysis:
- Network Models: Represent drugs, diseases, genes, and their interactions as nodes and edges in a network
- Analysing Interactions: Identify potential drug-disease relationships by analyzing pathways, networks, and interactions between different entities.

#### 3. Text Mining and Semantic Interference

- Biomedical Literature: Extract information about drugs and diseases from scientific literature using text mining techniques.
- Identifying Potential Indications: Detect potential new uses for existing drugs by analysing the relationships between drugs, diseases, and their mechanisms of action.
- 4. Structure-Based Approaches:



- Molecular Docking: Predict the bindingaffinity of a drug to a protein target using 3D models of the drug and protein.
- Homology Modeling: Build 3D models of proteins based on the structures of similar protein.

## DRUG

## Cancer

Drug repurposing in cancer therapy involves identifying new uses for existing, approved drugs, offering a faster and potentially cheaper approach to developing new treatments. A notable example is aspirin, originally used for cardiovascular conditions, now being explored for its antitumoral effects, particularly in triple-negative breast cancer.

- what is drug repurposing?
- Why Repurpose Drugs?
- Examples of Repurposed Drugs in cancer therapy? Benefits of Drug Repurposing:

## **Challenges of Drug Repurposing**

- **Finding the right target:** Identifying the appropriate cancer type and mechanism of action for the drug is crucial.

- **Dosage and Administration:** Determining the optimal dose and administration route for the repurposed drug in the cancer context can be challenging.

- **Clinical Trials:** Conducting clinical trials to evaluate the efficacy and safety of the repurposed drug in cancer patients can be complex and time-consuming.

## CONCLUSION

Drug repurposing has proven to be a powerful and increasingly important strategy in modern drug discovery, offering significant advantages over traditional drug development processes. As we look to the future, drug repurposing stands out as an effective tool for addressing unmet medical needs, speeding up drug development, and lowering associated costs. The approach is particularly valuable in an era where the need for rapid solutions to complex health challenges is more pressing than ever.

## Key take aways include:

- 1. Speed and Cost Efficiency: Repurposing existing drugs allows for a faster and more cost-effective path to discovering new treatments. Since these drugs have already undergone safety testing and have known pharmacokinetic properties, much of the early stage risk is mitigated, accelerating the process of bringing new therapies to market.
- 2. Addressing Unmet Medical Needs: Drug repurposing is especially crucial for diseases with limited treatment options, including rare and orphan diseases, as well as conditions with complex pathophysiologies like neurodegenerative diseases, cancer, and mental health disorders. It offers a potential solution for patients who otherwise face a lack of therapeutic options.
- 3. Leveraging Advanced Technologies: The integration of cutting-edge technologies like AI, machine learning, genomics, and big data analytics has enhanced our ability to identify repurposing opportunities more effectively By analysing vast amounts of data from diverse sources, researchers can pinpoint existing draughtsman have previously unrecognized therapeutic potential.
- **4. Regulatory Support:** Regulatory bodies, such as the FDA, are increasingly open to expedited approval pathways for repurposed drugs, recognizing their potential to address urgent public health challenges. This regulatory



flexibility helps to speed up the time from discovery to patient access.

**5. Pandemic Preparedness:** The COVID-19 pandemic underscored the importance of drug repurposing in rapidly addressing global health crises. By repurposing existing drugs for viral infections, researchers were able to identify potential treatments faster than starting from scratch.

However, while the potential is vast, drug repurposing is not without its challenges. Intellectual property concerns, clinical trial designs, and the need for large-scale validation still need to be navigated carefully. Despite these challenges, the benefits— especially in terms of cost, time, and patient access—make it an invaluable tool in the drug discovery toolkit.

## REFERENCES

- Ashburn, T.T., sThor, K.B. (2004). Drug repositioning: Identifying and developing newuses for existing drugs. NatureReviewsDrugDiscovery, 3(8), 673– 683.
- 2. Gottlieb, M., sPekar,T.(2017). Repurposing Drugsin the 21stCentury.Trendsin Pharmacological Sciences, 38(10), 830-836.
- Pushpakom, S., Iorio, F., Eyers, P. A., et al.(201G). Drug repurposing: Progress, challenges and recommendations. Nature Reviews Drug Discovery, 18(1), 41–58.
- Mendelsohn, J., sWeinberg, R.A. (2008).TheBiology ofCancer(2nd ed.). Garland Science.
- 5. Morris, Z.S., sGoldstein, L.B. (2015). Drug repurposing in he era of molecular medicine. Pharmacogenomics, 16(4), 453–463.
- Li, J., Zhang, Z., sZhang,W.(2020). Repurposing DrugsforAlzheimer's Disease: New Findings from Old Drugs. Neurotherapeutics, 17(2), 417–434.

- Kola, I., sLandis, J. (2004).Canthe pharmaceutical industry reduce attrition rates? Nature Reviews Drug Discovery, 3(8), 711– 715.
- Sánchez, M. S., sGarcía, M.T. (2018). Repurposing of drugsin the context of emerging viralinfections: Case studies and opportunities. Future Microbiology, 13(G),G37-G48.
- G.Benson, K. D.,s Kumar, P.(2017). Computationalstrategiesfor drug repurposing: Integrating bioinformatics and chemoinformatic sin drug discovery. Bioinformatics, 33(4), 585- 5G4.
- Roessner, D., s Peterson, J. (2015). Emerging Trends in Drug Repurposing and Clinical Trials: A Review of Opportunities and Challenges. The Journal of Clinical Pharmacology, 55(6), 640-651.
- 11. Luo, Y., Xie, Z., s Zhang, J. (2018). Drug repurposing strategies for the treatment of cancer. Journal of Cancer Research and Clinical Oncology, 144(4), 655-66G.
- 12. Gashaw, H.H., sFennel, A. (2021). DrugRepurposing forCOVID-13: A ComprehensiveReviewofMechanisms andClinical Trials. Frontiersin Pharmacology, 12, 618178.
- Ashburn, T.T., sThor, K.B. (2013). TheApplicationofDrugRepurposingtothe Treatment ofRare Diseases. Nature Reviews Drug Discovery, 12(4), 25G- 267.
- Mathew, J. R., s Nair,M.(2020).Artificial Intelligence in DrugRepurposing. Drug development research,81(1),46-55.
- 15. Bain, J. R., s Diehl, J.A. (201G).
  DrugRepurposing in Neurodegenerative Diseases: A Novel Therapeutic Avenue.
  Biochemical Pharmacology, 165, 1-11.
- 16. Zhang,L.,sZhang,Z.(2017).RepurposingExistingDru gsfor NewIndications: Opportunities

andChallenges.CurrentDrugDiscoveryTechno logies, 14(1), 38-44.

- 17. Zhang, R., sKim, S.(2016).AComprehensiveReviewoftheRole of Drug Repurposing inTreating InfectiousDiseases.ClinicalMicrobiology and Infection, 22(8), 74G-755.
- 18. Stern,S.

J.,sMehta,A.(2022).RepurposingDrugsforCan cerImmunotherapy: From Bench toBedside. Journal of Immunotherapy, 45(1), 35-45.

 1G. Xu, S., sCai, X. (2021). DrugRepurposing for Autoimmune Diseases: A Promising Strategy

forNovelTherapies.ExpertOpiniononDrugDis covery, 16(8), 8G7-G08.

20. Ekins, S., sWilliams, A. J. (2016).
FindingNewUsesforOldDrugs: The Role of Computational Drug Discovery in Drug Repurposing. Pharmacology s Therapeutics, 163,40-60.

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